STAR-LITE 2007: NOAA Ship *David Starr Jordan*
Weekly Science Report

Susan Chivers, Cruise Leader
30 September 2007

Science Summary: 23-29 September 2007

We could not have asked for better weather for our survey effort this week. As you may know from reading prior weekly reports written about this project, we spend 2 days on each transect; one day in passing mode and one day in closing mode, and our goal is to compare the sighting rates, species diversity and density, and oceanographic conditions between days, transects and legs. As you can see in the table below that summarizes our survey effort for the week in terms of distance and average Beaufort, our average Beaufort was less than 4 every day this week. The Beaufort scale characterizes sea state, and a Beaufort 3 is described as a 'gentle breeze' with the winds ranging from 7 to 10 knots creating occasional whitecaps. We did have some effort during the week with winds greater than 11 knots but not very much, and there was only one day when we had to dodge the scattered rain squalls characteristic of the ITCZ (Intertropical Convergence Zone). Thus, we had good sighting conditions for cetaceans and sea birds during nearly all of our survey hours, and the 3 transects covered this week (*i.e*., T3, T6 and T7 in the "Sampling effort; Passing mode" plot that follows) were completed in fairly comparable weather on passing and closing mode days. A fourth transect (*i.e*., T8) was also completed in good weather but only in passing mode; the closing mode effort for the transect is being completed today (Sunday 9/30).


Group of *Pseudorca crassidens* encountered on STAR-LITE 2007. Photo: Adam Ü

Again this week, the species most frequently seen on our paired sighting days were similar in that groups of small dolphin species dominated the sightings, and the most frequently identified species was the spotted dolphin (*Stenella attenuata*). The next most frequently identified dolphin groups were mixed species aggregations of spotted and eastern spinner dolphins (*S. longirostris*) followed by pure groups of eastern spinner dolphins. But there was patchiness in the distribution of these groups along nearly every transect that we completed. Along some transects, we would travel for miles (hours) without a sighting

and then have a flurry of small dolphin species sightings. One cannot help but wonder about this apparent patchiness in dolphin distribution. How big are these patches? Over what distance do these dolphins move to feed daily? We know from past research that spotted dolphin groups in the eastern tropical Pacific are dynamic. Spotted dolphin groups have been observed to increase in size during the course of the day and to fragment at night as they are feeding. And we know from tagging studies that group membership changes daily and only rarely are the same animals seen together on consecutive days. STAR-LITE is being conducted on a slightly larger scale than previous tagging studies and is on a much smaller scale than our regularly conducted line-transect abundance surveys. Perhaps some of the data collected on this cruise will shed some light on the scale of ecosystem patchiness that may help us understand more about dolphin movement patterns.

Looking at the oceanographic data this week, it looks like our southernmost waypoint is just on the thermocline ridge expected at the northern boundary of the North Equatorial Countercurrent. The thermocline ridge in this area has been correlated with high biological productivity and has been shown to be prime spotted dolphin habitat. Interestingly, the transects to and from the southernmost waypoint of this study area are the only ones on which we have seen blackfish species in addition to spotted and spinner dolphins. On leg 1, false killer whales (*Pseudorca crassidens*) were seen, and on this leg, killer whales (*Orcinus orca*), pygmy killer whales (*Feresa attenuata*) and Risso's dolphins (*Grampus griseus*) were seen. These transects were also the ones with the highest numbers of flying fish at dipnet stations this leg. See the "Dippers' Delight" report for more detail.

The transect (T7) on which we sighted the pygmy killer whales and Risso's dolphins was also interesting because it was the transect on which we noted the biggest difference in species composition between passing and closing mode days. On the closing mode day we saw twice as many species as we did on the passing mode day and we saw far fewer sightings of the smaller dolphin species. And the species of small dolphin seen also differed. On the closing mode we saw no pure schools of spotted dolphin but only a couple of sightings of spinner dolphins whereas on the passing mode day, we had quite a number of spotted dolphin groups. Furthermore, where we saw the pygmy killer whales and Risso's dolphins we did not see groups of the smaller dolphin species whereas we had seen only groups of the smaller dolphin species at that location on the previous day.

The boobies continue to compete for space on the jackstaff, and this week, there was a banded booby among them. Part of the leg band was readable, so we were able to contact the researcher with information about our re-sight and to find out where it was tagged. See the bird report for more detail.

Effort Summary for Marine Mammals

Date	Start/ Stop Time	Position	Total nm	Average Beaufort	Mode of Operations
092307	0914	N13:34.03 W106:14.89	100.4	2.5	Passing
	1930	N14:57.76 W105:17.74			
092407	0926	N13:33.70 W106:15.32	66.8	3.8	Closing
	1934	N14:52.99 W105:31.56			
092507	0919	N13:44.04 W105:21.10	97.3	2.0	Passing
	1900	N12:22.66 W104:26.44			
092607	0856	N13:43.84 W105:21.18	70.5	1.8	Closing
	1942	N12:28.16 W104:31.41			
092707	0919	N12:27.99 W104:29.84	94.5	3.7	Passing
	1920	N13:49.40 W103:35.23			

Date	Start/ Stop Time	Position	Total nm	Average Beaufort	Mode of Operations
092807	0932	N12:27.92 W104:30.09	56.2	3.4	Closing
	1854	N13:36.92 W103:43.88			
092907	0921	N13:44.08 W103:39.19	101.5	3.1	Passing
	1920	N15:09.18 W104:36.27			

Marine Mammal Sightings (Jim Cotton, Richard Rowlett, Juan Carlos Salinas, Suzanne Yin, Ernesto Vázquez, Adam Ü)

Code	Species	Number of Sightings
001	*Mesoplodon peruvianus*	2
002	*Stenella attenuata* (offshore)	47
003	*Stenella longirostris* (unid. subsp.)	1
010	*Stenella longirostris orientalis*	17
015	*Steno bredanensis*	3
018	*Tursiops truncatus*	5
021	*Grampus griseus*	3
032	*Feresa attenuata*	2
037	*Orcinus orca*	2
048	*Kogia sima*	6
051	*Mesoplodon sp.*	3
061	*Ziphius cavirostris*	2
070	*Balaenoptera* sp.	1
077	unid. dolphin	8
096	unid. cetacean	3
177	unid. small delphinid	41
277	unid. medium delphinid	5
Total		151

The locations of only the *Stenella attenuata, S. longirostris, Grampus griseus, Feresa attenuata, Orcinus orca*, and unidentified small delphinid sightings are plotted in the cetacean sighting maps included at the end of this report.

Photography (Adam Ü)

We added another species to our photographic catalog this week when two groups of pygmy killer whales were tolerant enough to allow close approaches. We also added one more tick mark in both the spinner dolphin and spotted dolphin categories, but unfortunately there were no successful laser dot images from any of the encounters.

Species	Common Name	Weekly photographs		Total photographs	
		Individuals	Schools	Individuals	Schools
Stenella attenuata (offshore)	Pantropical spotted dolphin	1	19	10	226
Stenella longirostris	Eastern spinner dolphin	1	23	2	38
Stenella coeruleoalba	Striped dolphin			2	20
Tursiops truncatus	Bottlenose dolphin			1	7
Feresa attenuata	Pygmy killer whale	2	42	2	42

Species	Common Name	Weekly photographs		Total photographs	
		Individuals	Schools	Individuals	Schools
Pseudorca crassidens	False killer whale			1	26
Total		4	84	18	359

Biopsy (Juan Carlos Salinas, Ernesto Vásquez, and Suzanne Yin)

No additional news this week.

Species	Common Name	Weekly		Total	
		Samples	Takes	Samples	Takes
Pseudorca crassidens	False killer whale	0	0	1	4
Stenella attenuata	Pantropical spotted dolphin	0	0	2	10
Tursiops truncatus	Bottlenose dolphin	0	0	1	7
Total		0	0	4	21

Acoustic Squeakly (Shannon Rankin)

There seemed to be few pauses between acoustic detections this week, with one outstanding exception: for the better part of Sunday, the dolphin schools barely managed a peep or a squeak. Of the 18 sightings before dinner, only four of these were detected by acoustics, and many of these consisted of only a few sounds. Why in the world would such vociferous animals go silent? Killer whales. This is not the first time I have noticed this relationship, and what amazes me is how dolphin schools over such a great area can react to the presence of these predators. Killer whales that feed on fish are known to be highly vocal, but killer whales in the tropics feed on other cetaceans, and they are notoriously silent. What other cues are the dolphins using to sense the presence of killer whales?

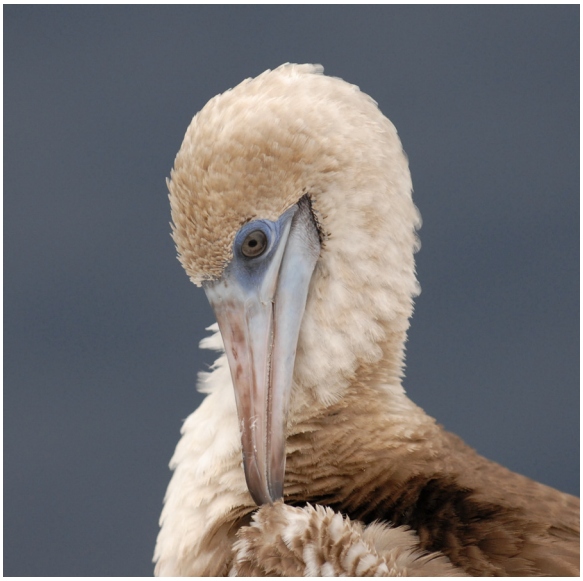
After a few hours, the dolphins were back to their chatty selves. Acoustic detections skyrocketed to 30 detections on Thursday, and culminated in a ridiculous 16 detections in only two hours on Saturday. Both the array and I were frazzled to the very brink of sanity – when the array finally gave in. Can't say I blame it, to be honest. This week I managed 82 detections in 3.5 days effort, including the half day of orca-induced silence. Unfortunately, the array did not survive the onslaught, and this upcoming week will begin the post-mortem examination. All signs point towards sheer exhaustion, but with luck I'll get her up and running for the next passing-mode day.

See plots included at the end of this report for the location of acoustic detections of dolphins and the acoustic detections that were matched to a visual sighting.

Seabird Report (Michael Force and Sophie Webb)

The observer team survived another week of bombing raids by a large squadron of Red-footed Boobies, strafing the flying bridge at every opportunity. There was some minor collateral damage—splattered computer screens, binoculars—and some direct hits. Their excretory prowess notwithstanding, these feathered buffoons provided hours of entertainment (and extra cleanup duties) as they squabbled over limited prime real estate atop the ship's jackstaff. There are dozens of other perches aboard the ship, ignored in favor of this one, allowing them to keep a sharp lookout for flying fish flushed by the ship and to carpet-bomb the flying bridge. Most days

there are eight, sometimes as many as 30, Red-footed Boobies, along with Brown, Masked, and the occasional Nazca Booby, all jockeying for a spot on a small platform that has room for maybe eight birds (more when they stack up on top of each other). We now have a greater appreciation for the historical importance of guano islands as the foredeck of the McArthur II begins to look like one. An immature booby, wearing an id tag in the form of an aluminum band on its right leg, revealed just enough information for us to determine who had banded it. An e-mail from David Anderson told us that he had banded it as a nestling on Isla Española, in the Galapagos, 1300 nm to the south, providing incontrovertible proof that it was a Nazca Booby. Identifying immature Nazca and Masked Boobies can be extremely difficult; however, it's so much easier when the bird is wearing a tag that says "Hi, my name is Nazca." We saw our first adult Red-footed Booby of the cruise when a white morph joined the fray (all of the birds up to this point have been immatures).



Booby preening while resting aboard NOAA Ship *McArthur II*. Photo: Adam Ü

Squinting through our attendant booby flock, we found 24 species this week, a number remaining very consistent from week to week. This value, however, masks seasonal changes in the avifauna. Dark morph Wedge-tailed Shearwaters, formerly outnumbering the light morph variety by a huge margin, are now in the minority. Overall, numbers of Wedge-tailed Shearwaters have decreased dramatically from previous weeks, while southbound migrants such as jaegers, Red Phalaropes and Arctic Terns all experienced slight increases. Other southbound migrants, somewhat expected, but out of place nonetheless, were Cliff and Bank Swallow, Red Knot and American Redstart. An adult Sooty Tern in a feeding flock was only the second one we've seen this month.

See the plots included at the end of this report for location of seabird flocks recorded. Only the key indicator species of flocks are plotted.

Oceanographic Operations (Candy Hall, Ryan Driscoll, Fionna Matheson and Vicki Pease)

Oceanography sampling continues on track, achieving all but one of its objectives for this week. Sadly one Manta tow was cancelled as the J-Frame was acting up slightly. Many thanks to A/CME Williams and 2AE Gill for the delicate techniques they've employed to ensure that we are able to do tows each night. A lesson in engineering I don't think any of us will forget, especially aspiring-engineer SST O'Neal!

The weather this leg has been fortuitous enough to allow us to sample from the extreme west to the extreme east, as well as the northerly and southerly regions of our survey area. What is apparent in our raw data is a definite meridional and zonal rise in the thermocline depth (identified as the 20° C isotherm in this case) towards the southeast. The mixed layer depth is following the same trend. However, with

only a difference of 34 m between the maximum (73 m between WP1 and WP2) and minimum (33 m near WP5) thermocline depth, we hesitate to suggest that we've crossed into the North Equatorial Countercurrent, but rather we believe that we may be just on its northern boundary.

Our sea surface temperature (SST) time series for this leg shows that values have not varied beyond the minimum of 28.8° C and maximum of 30.4° C. Most of this deviation may be attributed to solar radiation diel variation; resulting in an average SST of 29.6° C for our leg 2 track lines. The associated sea surface salinity has peaked at 33.92 psu, decreasing to 32.93 psu as we moved towards the southeast. With our current northwesterly trackline, sea surface salinity values are increasing with each nautical mile, as is our anticipation of the World Cup Rugby match between South Africa and the USA on Sunday night. Good luck, USA, you're going to need it against my boys! Go, Springboks!!!!

Date	CTD	XBT	Bongo tow	Manta tow
092307	2	4	4	1
092407	2	4	4	1
092507	2	4	4	1
092607	2	4	4	1
092707	2	4	4	1
092807	2	4	4	0*
092907	2	4	4	1
Total	14	28	28	6

*The J-Frame malfunctioned, causing a delay in net tow operations. Due to the steaming time needed to transit to the morning's waypoint, there was insufficient time remaining to complete both net tows.

Dippers' Delight (Jim Cotton, Juan Carlos Salinas, Ernesto Vázquez, Adam Ü, and Ryan Driscoll)

It was a good week for the dip netters with 71 specimens collected during eight of our nine stations; one station was rained out. Flyingfish continue to be patchy in their distribution in the study area with the majority (80%) of the fish collected at three stations.

The numbers of stomachs collected for the flyingfish food habit study were:
29 - Two winged flyingfish, (*Exocoetus* sp.)
1 - Black winged flyingfish, (*Cheilopogon xenopterus*)
4 - Four winged flyingfish, (*Hirundichthys* sp.)
4 - Four winged flyingfish, (*Cheilopogon* sp.)
38 = Total

The examination of one *Exocetus* stomach showed the following contents by volume:
15% - fish scales, perhaps an artifact of contamination.
75% - copepods.
9% +- amphipods plus a couple pteropods.
(Partial contents from the lower gut of another *Exocetus* revealed Euphausiid parts.)

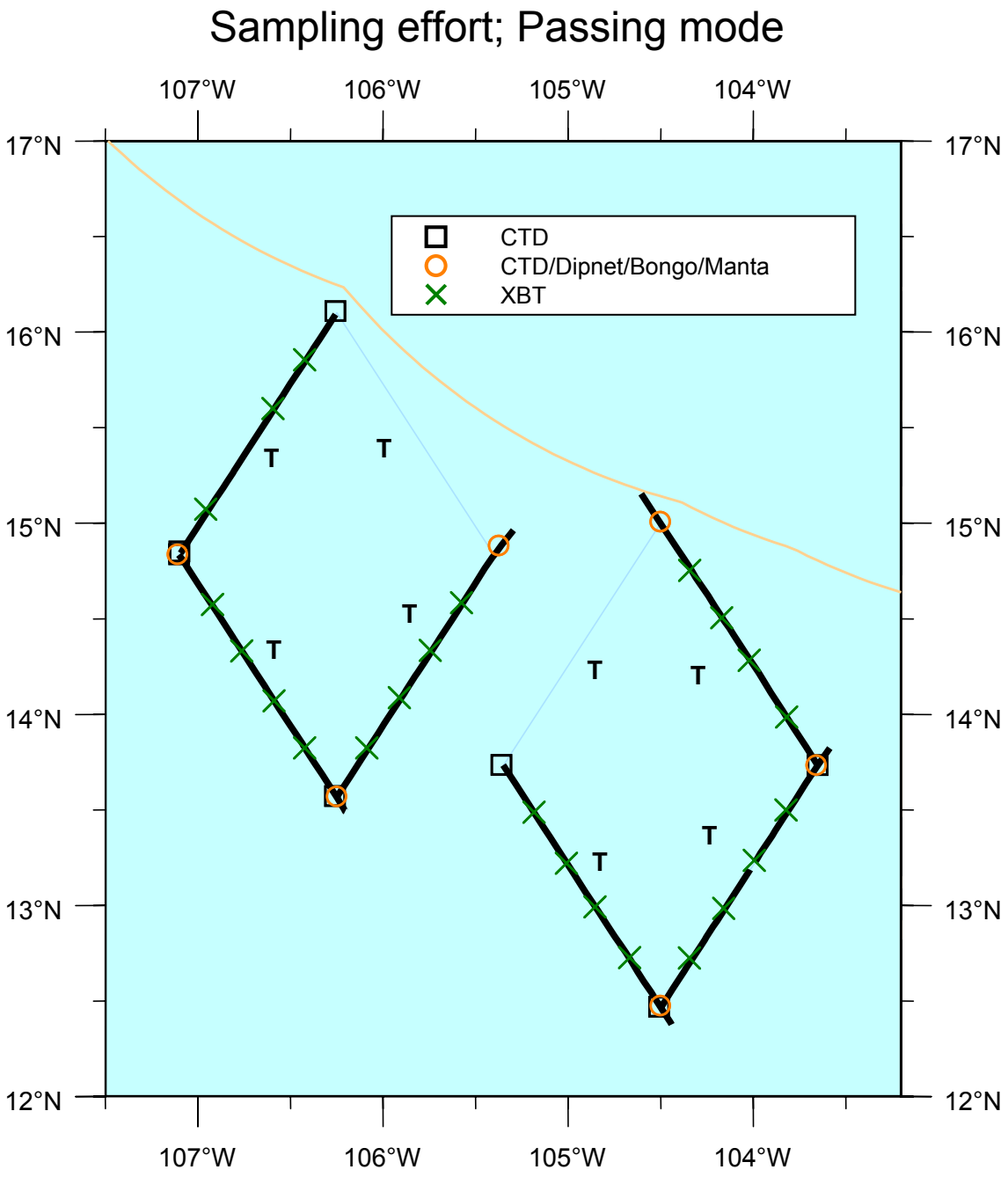
Other animals seen beneath our lights this week were; Mahi mahi (Coryphaenidae), bullet tuna (*Auxis rochei*), lantern fish (Myctophidae), purple back squids (*Sthenoteuthis* sp.) and an unidentified shark.

New to the aquarium collection this week was a single pelagic triggerfish (Balistidae).

Net totals for the week:

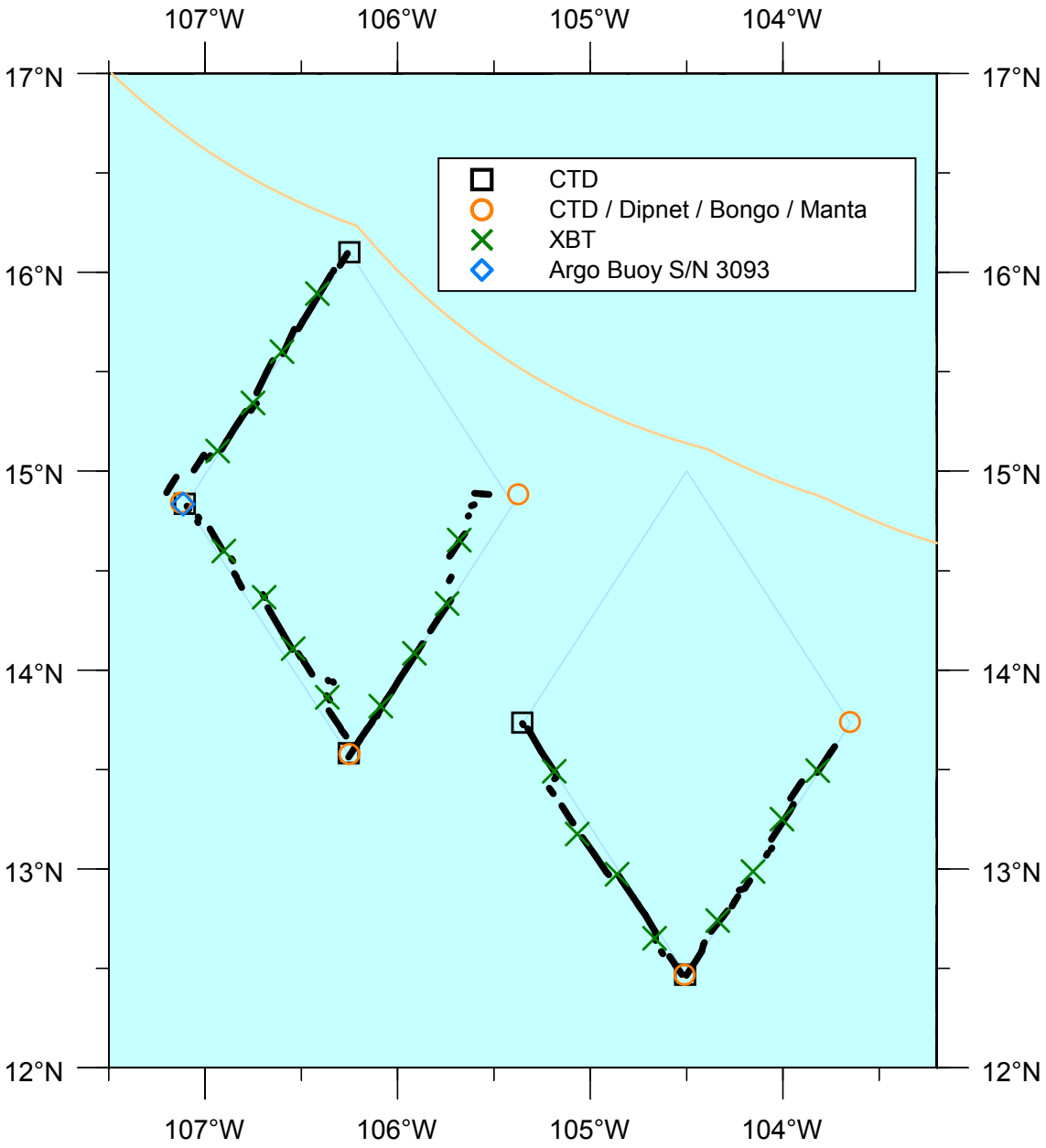
34-Two winged flyingfish, (*Exocoetus* sp.)
21-Short winged flyingfish, (*Oxyporhamphus* sp.)
8- Four winged flyingfish, (*Hirundichthys* sp.)
5- Four winged flyingfish, (*Cheilopogon dorsomacula*/ *xenopterus*)
1- Four winged flyingfish, (*Cheilopogon xenopterus*)
1- Triggerfish, (Balistidae)
1- Unidentified juvenile fish.

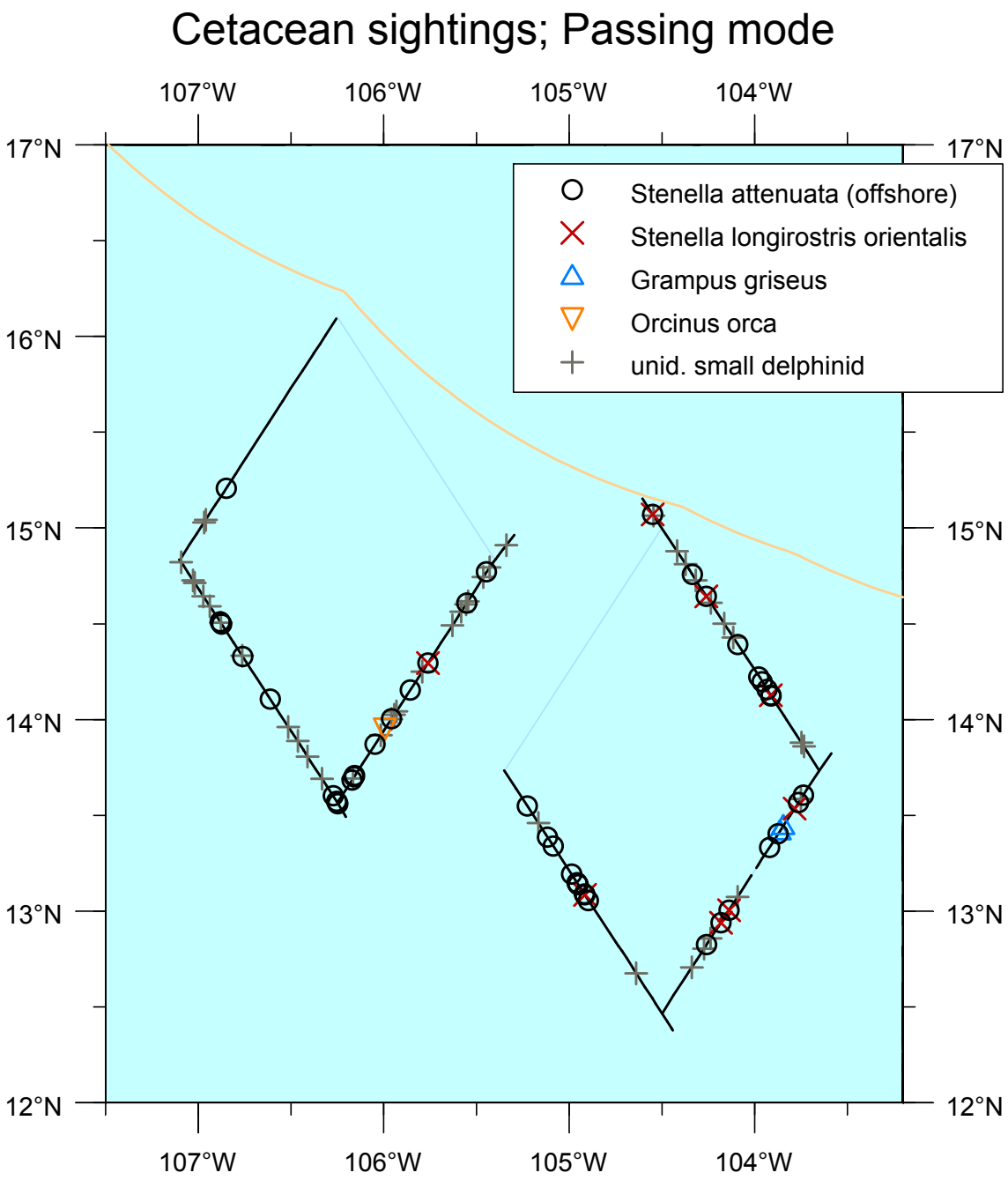
How many fish can an adult Brown Booby hold in its stomach? The answer is at least 13! Our flyingfish collection was enhanced this week when a female Brown Booby (*Sula leucogaster*) deposited its stomach contents on the deck prior to flying away. The odiferous collection included: 5 - short winged flying fish (*Oxyporhamphus* sp.), 2 - two winged flyingfish (*Exocetus* sp.), 1 - four winged flyingfish (*Cheilopogon* sp.), 4 - unidentified fish (probably *Oxyporhamphus* sp.), and one Remora.

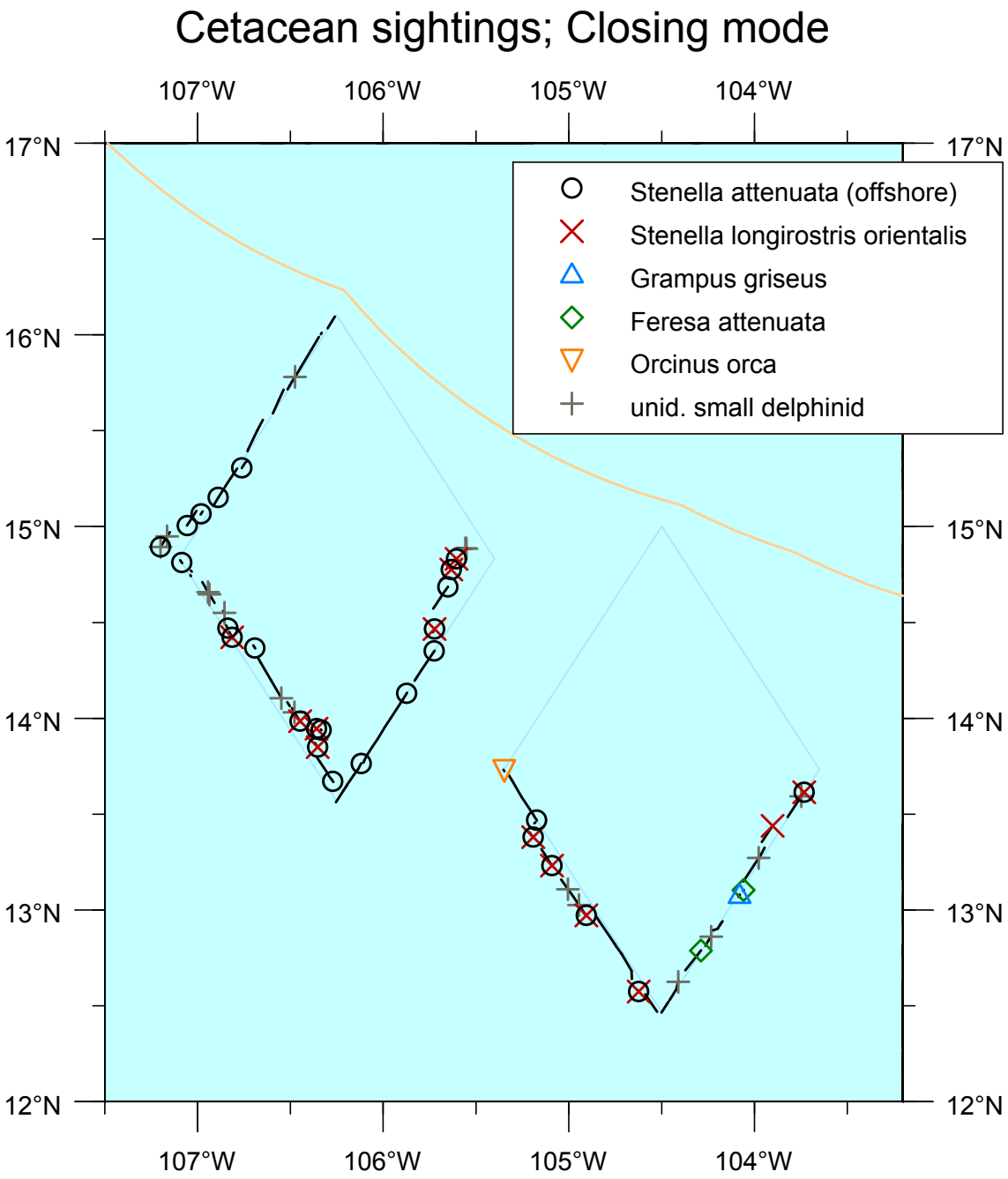


Leg 2 survey coverage: Transects T1 and T2 were completed during the week ending 22 September; transects T3, T6, T7 and T8 were completed this week (23-29 September 2007). T8 was only surveyed in passing mode this week; closing mode coverage will be completed next week.

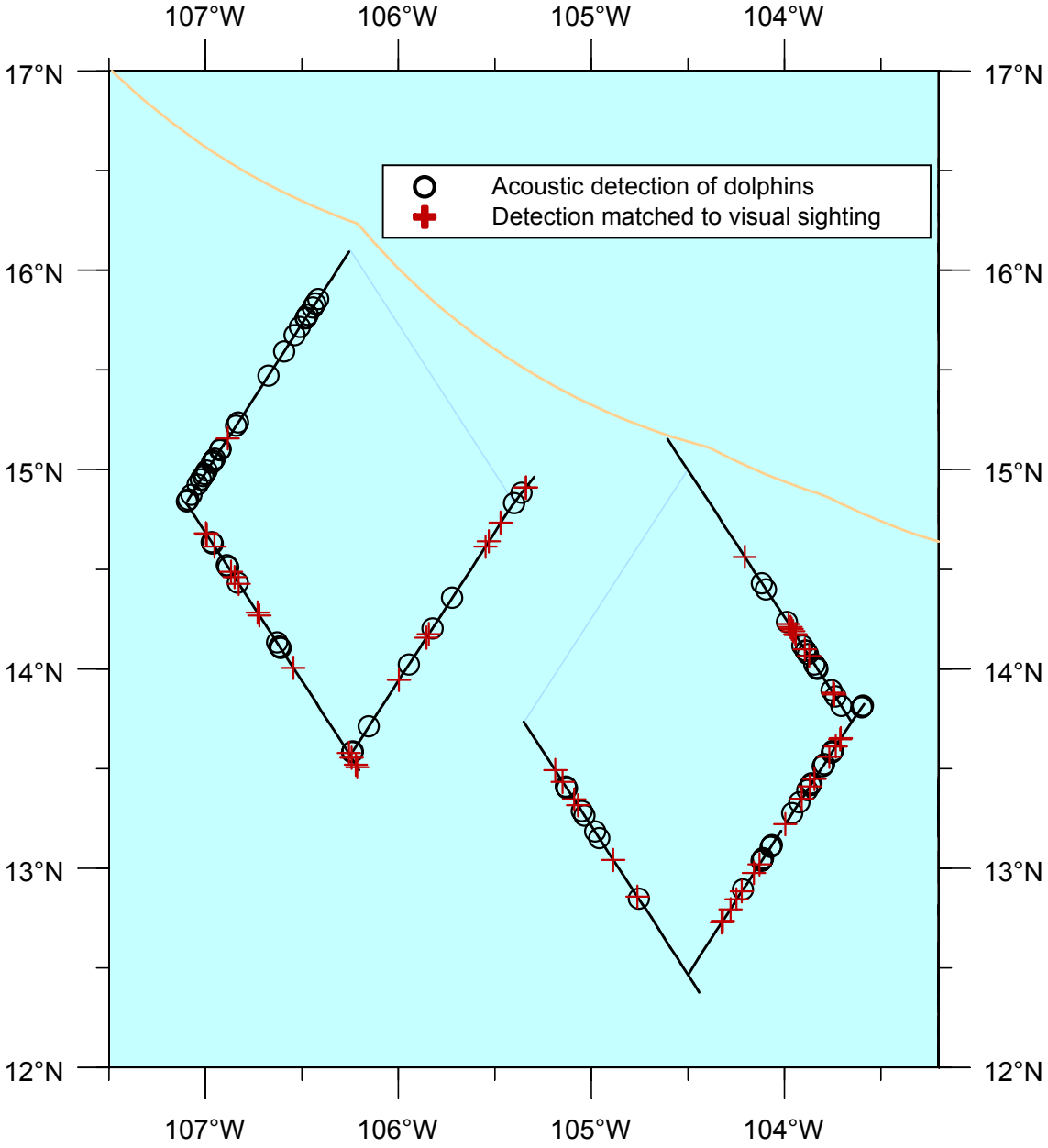
Sampling effort; Closing mode



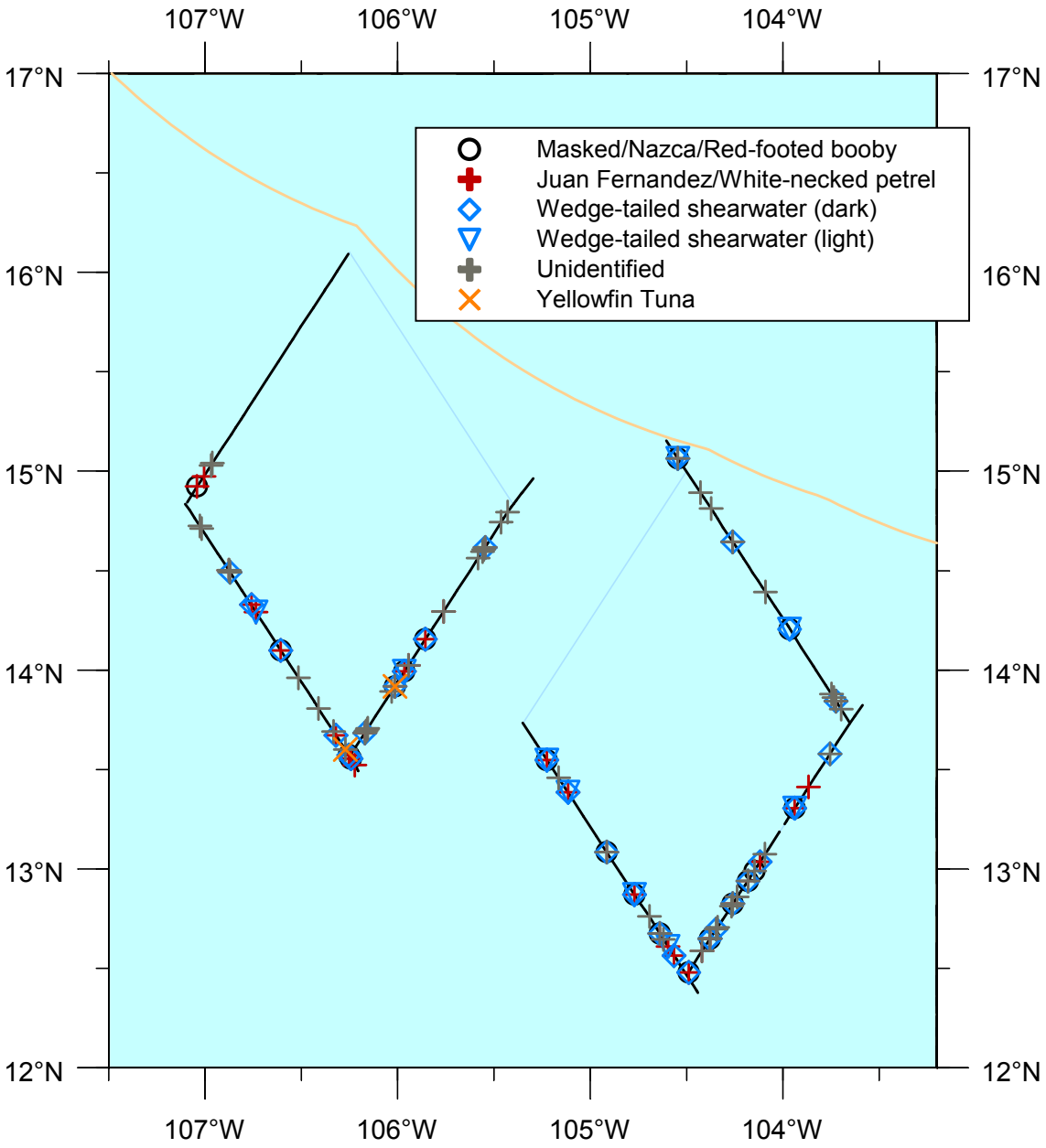

Cetacean sightings; Passing mode
107°W
106°W
105°W
104°W
17°N
16°N
15°N
14°N
13°N
12°N
Stenella attenuata (offshore)
Stenella longirostris orientalis
Grampus griseus
Orcinus orca
unid. small delphinid


Cetacean sightings; Closing mode
107°W
106°W
105°W
104°W
17°N
16°N
15°N
14°N
13°N
12°N
Stenella attenuata (offshore)
Stenella longirostris orientalis
Grampus griseus
Feresa attenuata
Orcinus orca
unid. small delphinid

Acoustics, Passing mode



Seabird flocks; Passing mode



Seabird flocks; Closing mode